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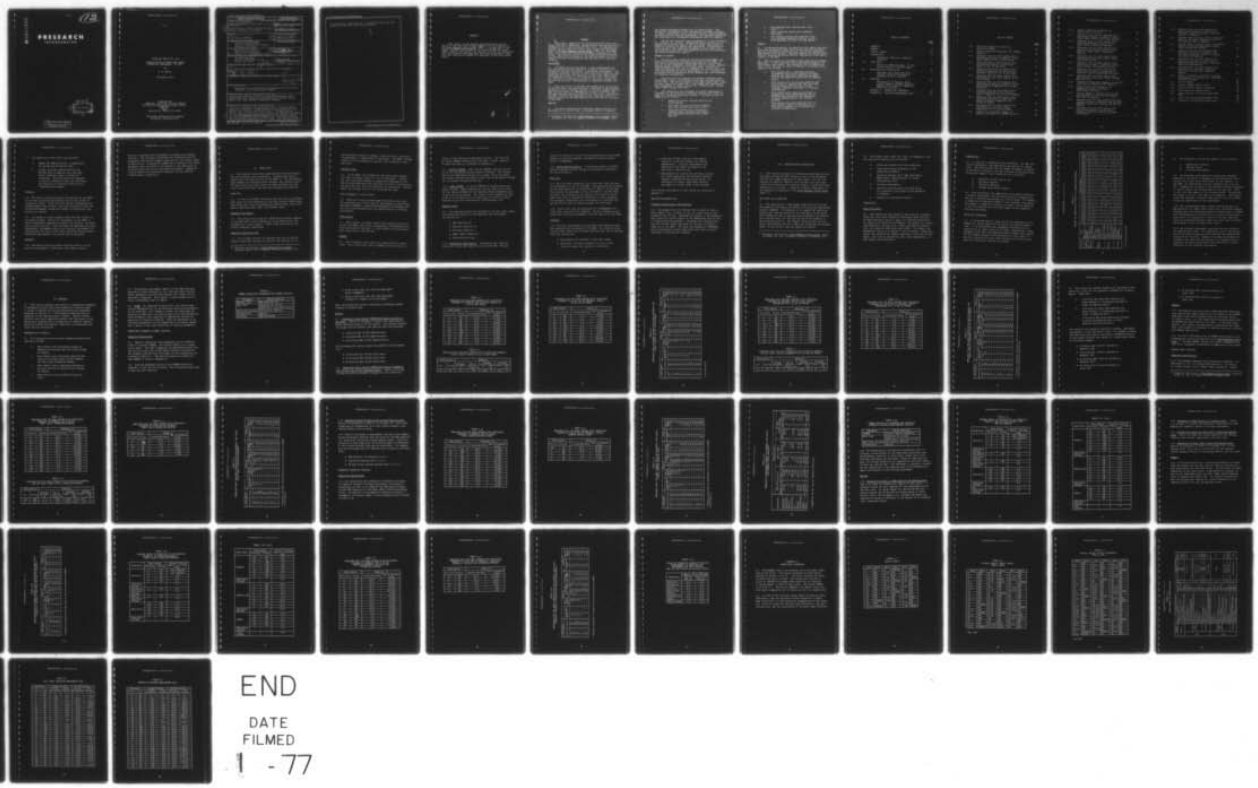

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Technical Report No. 315

QUANTIFICATION OF WORK LOAD VERSUS CAPABILITY IMBALANCES: FF-1053

by

G. H. Smith

29 October 1976

Prepared for
Commander, Naval Sea Systems Command
Surface Ship Maintenance Project Office
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The report summarizes the quantification of work load versus capability imbalances, using selected manning sensitivity parameters, for a ship of the FF-1052 class. It explains the actions taken to add the FF-1052 class to the data base developed in the Fleet Manpower Policy Study (Presearch Technical Report No. 290, 12 February 1976) including minor deviations from the data development procedures of that study. The detailed results of the quantifications described in this report are contained

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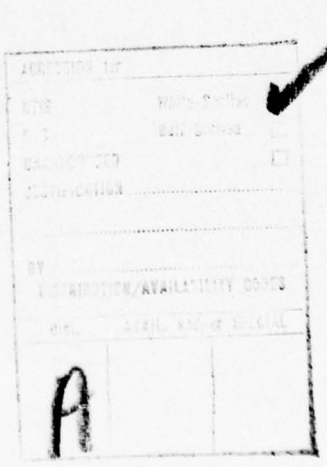
in the machine reports on the 21 simulations that were conducted with the ship work load algorithm.

ABSTRACT

This study, for the Surface Ship Maintenance Project Office of the Naval Sea Systems Command, was an extension of the Fleet Manpower Policy Study (FMPS) to include the FF-1052 class. It added the FF-1053 to the existing FMPS data base (AFS-5, DDG-15, and LSD-35) and involved a series of simulations with the Presearch-developed ship work load algorithm to identify work load versus capability imbalances at the work center level.



SUMMARY

1. This report summarizes the quantification of work load versus capability imbalances, using selected manning sensitivity parameters, for a ship of the FF-1052 class. It explains the actions taken to add the FF-1052 class to the data base developed in the Fleet Manpower Policy Study (FMPS), 1/ including minor deviations from the data development procedures of that study. The detailed results of the quantifications described in this report are contained in the machine reports on the 21 simulations that were conducted with the ship work load algorithm.

BACKGROUND

2. The FMPS analyzed the impact of ship manning policies and the operational environment of a ship on its ability to accomplish required work load in a peacetime environment. The principal analytical vehicle in that study was a ship work load algorithm with which the capability of each work center could be evaluated relative to its required work load. The results are reflected as deferred work load if work load exceeds capability and as slack (undertasking) if capability exceeds work load.

3. Both the thrust of the FMPS and specifically the utility of the ship work load algorithm were recognized as having great potential value to ongoing analyses in the Ship Support Improvement Project (SSIP), a comprehensive program to achieve and maintain adequate material condition of the fleet. Accordingly, the FMPS data base was extended to add a ship class that is central to many of the SSIP analyses but that was not included in the FMPS.

PURPOSE

4. The work load/capability imbalance quantifications were developed as an initial step in a planned effort to improve

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1/ Presearch Incorporated, Fleet Manpower Policy Study, Technical Report No. 290, Arlington, Virginia, 12 February 1976.

the organic maintenance capability of surface ships. That effort will introduce and test appropriate innovative changes in ships' organization, work load distribution, improved methods and materials for facility maintenance, and improved scheduling and utilization of intermediate maintenance activity support.

5. The FF-1052 class has been designated to act as a platform for this part of the SSIP. Determining where initiatives are needed and evaluating them as they are tested require that a baseline situation be defined and quantified. The quantifications and data base expansion documented in this report and the associated ship work load algorithm reports will facilitate the baseline definition process.

SUMMARY OF EFFORT

6. The major data collection and data base development procedures were basically unchanged from those of the FMPS. In-port work load measurement was accomplished by a work study team of the Navy Manpower and Material Analysis Center, Pacific. The USS ROARK (FF-1053) was the sample ship. The activity sampling technique was used to determine the in-port work load, with a measurement period of approximately 4 wk. Training requirements and reconstructed actual manning data were developed by Presearch Incorporated.

7. Discrete data for unauthorized absence, temporary additional duty (other), and ordinary leave were not developed for the FF-1053. The data developed in the FMPS showed such a small variance among ship types that it was deemed both unnecessary and uneconomical to develop values for a fourth ship. Accordingly, FMPS averages were used.

8. The simulations were designed to provide comprehensive treatment of the sensitivity parameter options most likely to apply in a baseline definition process. The more salient are summarized as follows:

- Condition IV work load was used for all at-sea phases
- Both cold iron and auxiliary steaming work load options were used in port
- Inevitable productivity detractors--ordinary leave, unauthorized absence, and temporary additional duty--were applied

- Five manning level options were introduced
- Three different operational schedules were used
- Two training options were applied, plus a no-training simulation for use in zero-base appraisal of total training impact.

RESULTS

9. As indicated earlier, the nature of this effort was basically one of quantification, both in the data base extension and the simulations to identify work load versus capability imbalances in the FF-1053. Detailed reports are now available both for baseline definition and for reference by other participants in the SSIP.

10. Several sensitivity parameters were selected for summary appraisal. In this analysis, four significant categories of work centers were noted. The categories and the general potential they describe in terms of needing or providing assistance are as follows:

- Work centers with a continuing increase in deferred work accrual and with no undertasking (may need help, depending on magnitude of the deferral relative to the manning level)
- Work centers with fluctuating deferred work accrual and no undertasking (may need help, with alternate possibilities of work transfer, external assistance, or internal rescheduling)
- Work centers with continuing increase in accumulated slack (undertasking) and no deferred work (candidate for assistance to those needing help or for reduced manning)
- Work centers with both deferred work and slack present (must be evaluated on a case basis; probably can be helped with internal rescheduling).

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I. INTRODUCTION

1.1 This report contains pertinent summary results of a study that investigated the existence and nature of imbalances between work load and capability for a ship of the FF-1052 class. The effort was essentially an extension of the Fleet Manpower Policy Study (FMPS), [1/] although, as will be explained below, the thrust and objectives were narrower in scope than those of the FMPS. The work was conducted for the Surface Ship Maintenance Project Office (PMS-306) under Contract No. N00014-74-C-0434.

BACKGROUND

1.2 The Fleet Manpower Policy Study analyzed the impact of ship manning policies and the operational environment of a ship on its ability to accomplish required work load in a peacetime environment. A variety of factors that affect the accomplishment of work were identified, pertinent data bases established, and evaluations performed with a ship work load algorithm.

1.3 Three classes of ships were included: AFS-1, DDG-2, and LSD-28. The results of the analyses, particularly the utility of the algorithm in identifying the impact of work load and manning options, suggested expansion of the study base.

[1/] Presearch Incorporated, Fleet Manpower Policy Study, Technical Report 290, Arlington, Virginia, February 1976.

1.4 A ship of the FF-1052/78 class was selected for additional data gathering. [2/] This class has been designated to act as a platform in the Ship Support Improvement Project for the testing and validation of certain maintenance-related initiatives. Accordingly, the USS ROARK (FF-1053) was designated for the in-port work measurement and data collection. [3/]

1.5 The scope of the proposed initiatives is expected to cover a wide range of options, both on and off the ship. One of the efforts will concentrate on improving the organic maintenance capability through introduction and testing of appropriate innovative changes in the ship's organization, work load distribution, improved methods and materials for facilities maintenance, and improved scheduling and utilization of intermediate maintenance activity support.

OBJECTIVE

1.6 While the study was an extension of the FMPS with respect to broadening the data base, the basic thrust of the FF-1053 effort was somewhat different. The FMPS focused on the basic questions of adequacy and inadequacy of SMD III manning and the need for additional manning policy parameters, with no special emphasis on a particular ship class. The FF-1053 effort builds on the knowledge gained in the FMPS and, because of the need to identify both baseline imbalances and the impact of proposed initiatives, concentrates on those quantifications for a single ship class.

2/ CNO Message 092204Z, April 1976.

3/ CINCPACFLT Message 282304Z, May 1976.

1.7 The objective of this effort was two fold:

a. Expand the FMPS data base, as appropriate, to include the FF-1052/78 class.

b. Conduct selected simulations with the FF-1053 data to quantify work load capability imbalances under a variety of conditions. The simulations are designed to provide information that will facilitate the definition of baseline conditions for a peacetime environment.

APPROACH

1.8 The effort closely paralleled the approach of the FMPS in the data collection and reduction and in the conduct of simulation studies. Since the basic factors influencing work accomplishment were the same, the study consisted of data collection/development, design and conduct of simulations, and analysis of results.

1.9 The change in thrust signaled above was most evident in the analysis phase. Unlike its counterpart in the FMPS, in which considerable comparative analysis was involved, the focus here was more absolute. With the causes of imbalance previously established, the emphasis was on the locations and amounts of deferred work and slack, since these statistics form the basis from which improvements will proceed and be evaluated.

CONTENTS

1.10 The ensuing sections contain pertinent details on the data base development, simulations, and summary results.

Section II explains data development procedures and responsibilities. The rationale surrounding the simulations and the parameters selected for summary appraisal are the central topics in Section III. Findings are summarized in Section IV for those parameters that are likely to be debated in the definition of baseline conditions for the peacetime environment. Appendices A and B present the operational schedules and the required training data, respectively.

II. STUDY DATA

2.1 This section covers both responsibilities and procedures for data collection and development. In most cases the procedures were the same as those of the FMPS. [1/] For convenience, data elements are presented under headings that identify where the same values were used, where the same procedures but discrete values were used, and where the procedure was modified.

FMPS DATA

2.2 In view of the FMPS conclusions and the desire to minimize both study cost and disruption of the ship routine, FMPS average data values were used for unauthorized absence (UA), other temporary additional duty (TAD), and ordinary leave.

Unauthorized Absence

2.3 The average time values for unauthorized absence computed in the FMPS were 0.242 hr/wk/man for at-sea phases and 0.375 hr/wk/man for in-port phases. These values were used in the FF-1053 imbalance simulations.

Temporary Additional Duty

2.4 This element reflects the average time lost to TAD for reasons other than training or official ship business (e.g.,

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1/ Presearch Incorporated, Fleet Manpower Policy Study, Technical Report 290, Arlington, Virginia, February 1976.

off-ship medical/dental treatment, hospitalization, disciplinary/personnel, or administrative functions). The FMPS' average values of 0.452 hr/wk/man at sea and 0.387 hr/wk/man in port were used.

Ordinary Leave

2.5 In the FMPS, the averages for the three ships showed a very small variance (from 2.27 to 2.35 hr/wk/man). Further, the test simulations showed no significant advantage to the use of leave experience data that were discrete to rating group and phase and that were very difficult to reconstruct. Accordingly, the average value of 2.31 hr/wk/man was used.

FMPS PROCEDURE, FF-1053 VALUES

2.6 FMPS data collection/development procedures were used for identification of work centers, development of operational schedules (OPSKEDs), determination/designation of manning levels, work load determination, and quantification of training requirements.

Work Centers

2.7 Work centers, as coded, reflect the ratings by division. As with the FMPS, the division designations and parameters are those prescribed by the SMD. In this fashion, 35 work centers were identified for the FF-1053.

OPSKEDs

2.8 Three schedules were used in the quantification simulations. Two of these were typical OPSKEDs and were identical

except in the handling of deployment periods. The third was an actual OPSKED reconstructed from ships' records. Details by phase and week are contained in Appendix A.

2.9 Typical OPSKEDs. Both typical OPSKEDs covered a period of 191 wk, the period between regular overhauls. One treated each of the deployment periods as a single, all-at-sea phase. The second reflected the normal in-port and at-sea phases throughout, including the deployed periods.

2.10 Actual OPSKED. An actual OPSKED was reconstructed from ships' records. Phase nomenclature was the same as that used for the typical OPSKED with the deployed period fragmented into in-port and at-sea phases. The length of the schedule was held at 86 wk to coincide with the time frame for which the actual manning history was reconstructed (see Paragraph 2.13).

Manning Levels

2.11 Five manning options were included in the data base, using the conventions applied in the FMPS data base development. The options are:

- SMD Condition III
- Notional Condition IV
- Notional Condition V
- OpNav 1000/2 authorized
- Reconstructed actual.

2.12 Conditional Requirements. The manning level used for Condition III was that depicted in the class SMD. Manning

levels for Conditions IV and V were obtained from notional SMDs prepared by the Navy Manpower and Material Analysis Center, Pacific (NAVMMACPAC).

2.13 Actual Manning History. A historical profile of weekly assigned strength in each rating was developed by Presearch for an 86-wk period.

Work Load

2.14 With one minor exception, the at-sea work load data base was developed as it was in the FMPS. The exception was dictated by the nonavailability of a Condition III SMD for the FF-1053. This problem was addressed by using the SMD for the USS STEIN (FF-1065) and adjusting the preventive and corrective maintenance work load to reflect the difference in major equipment. The equipment differences were established by a detailed comparison of the lists of effective pages for both ships.

2.15 In-port work load was determined by a NAVMMACPAC work study team, using activity sampling. Activity categories and prescribed statistical parameters were the same as for the FMPS.

Training

2.16 Training requirements were quantified by Presearch using the dimensions and procedures of the FMPS. The required training data base offers the following dimensions for use in manning/work load simulations:

- Requirements are discrete to each work center.
- Ship-level and higher authority directed training requirements are separately identified.

- Fixed and variable training requirements (relative to the work center) are treated appropriately. Variable requirements are sensitive to the number of people in the work center; fixed are not.
- Requirements for on-ship and off-ship training are stated separately, and off-ship training, normally conducted during in-port phases, is converted to a weekly requirement based on the number of in-port weeks in the schedule.

The training requirements by work center are contained in Appendix B.

MODIFIED PROCEDURE DATA

Preventive Maintenance (PM) Variance

2.17 The categorization of PM work load in terms of time or place demand (i.e., in port, at sea, or either) was not performed for the FF-1053. Estimates of variance in PM accomplishment during the various phases of the OPSKED were derived with a slightly modified procedure. Estimates were obtained from only the FF-1053 rather than from the Atlantic and Pacific fleets as in the FMPS. The effort was managed by NAVMMACPAC, and the maintenance records apparently were used to greater advantage in deriving the estimates.

III. QUANTIFICATION SIMULATIONS

3.1 This section discusses the simulations performed and the rationale surrounding their design as well as the parameters selected for summary appraisal in this report. For the convenience of those not familiar with the ship work load algorithm, which served as the simulation model, a brief functional description is provided. A complete technical description of the algorithm is contained in the Fleet Manpower Policy Study (FMPS). [1/]

SHIP WORK LOAD ALGORITHM

3.2 The algorithm is a time-staged comparison of work load and capability throughout the phases of a prescribed operational schedule (OPSKED). Its function is to compute the difference between work load and capability for each phase of the designated OPSKED and then to appropriately accumulate the deferred work load man-hours over the full period of the schedule or any prescribed portion. The outputs--deferred hours of work and/or undertasking--provide a means for evaluating the manpower impact of various work load and capability options.

1/ Presearch Incorporated, Fleet Manpower Policy Study, Technical Report No. 290, Arlington, Virginia, 12 February 1976.

3.3 The primary input items and, thus, the dimensions used for sensitivity analysis are as follows:

- At-sea and in-port work load conditions
- Order and duration of phases of the operational schedule
- Personnel manning level (SMD requirement, OpNav 1000/2 authorizations, or actual ship manning level)
- Training requirements
- Variation from the base work load values as a function of the phase of the operational schedule
- Productivity detraction factors.

SIMULATIONS

Design Rationale

3.4 The simulations were guided by the objective of quantifying work load versus capability imbalances under the sets of conditions most likely to apply in a baseline definition. For some of the sensitivity parameters, the option for a peacetime baseline is obvious (e.g., leave, unauthorized absence (UA), and temporary additional duty (TAD)). For others, the appropriate choice of an option is not so obvious. These parameters were selected for summary appraisal in the body of this report, with sets of simulations used, where appropriate, to show impacts and differences.

Composition

3.5 A total of 21 simulations were conducted. For some sensitivity parameters, the same option was used in all simulations. The options that were not common throughout are shown in the matrix in Table 3.1 as they occurred in the simulations. The options common to all simulations are as follows:

- Condition IV work load at sea
- UA factor applied
- TAD factor applied
- Average leave factor applied.

3.6 With the matrix, the composition of any given simulation is readily established, and the identification of appropriate sets for a specified investigation is facilitated. For example, a comparison of Simulation Number 16 (no training) with Simulation Number 9 (composite training, all other options identical to 16) will show the full zero-base impact of the composite training requirement.

SELECTIVE PARAMETERS

3.7 As discussed earlier, some sensitivity parameters do not suggest an obvious option for the process of baseline definition. It is anticipated that judgmental decisions will be required for at least a portion of these. Consequently, those parameters that show considerable potential impact were singled out for summary analysis and presentation in this report to provide a quantitative base--both absolute and relative--from which the decision on options can proceed.

TABLE 3.1

MATRIX OF SENSITIVITY OPTION BY SIMULATION NUMBER*

Parameter	Option	Simulation Number																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
In-port work load	Cold iron	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
	Auxiliary steaming																			X		X
PM variance	Considered		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Not considered	X																				
Manning level	SMD III	X	X	X	X	X															X	X
	Notional V																		X	X		
	OpNav 1000/2 authorized									X	X				X	X	X	X				
	Actual						X					X										
	Actual average							X	X				X	X								
OPSKED	Actual						X					X										
	Typical, deploy intact	X	X	X				X		X			X		X		X				X	
	Typical, deploy fragmented				X	X			X		X			X		X		X	X	X		X
Training	SMD allowance	X	X		X							X	X	X	X	X						
	Composite requirement			X		X	X	X	X	X	X								X	X		
	None																X	X			X	X

* X indicates option used.

3.8 The parameters selected for emphasis were as follows:

- Operational schedules
- Manning levels
- Training requirements.

3.9 The principal investigation of operational schedules centered on the impact of fragmenting the deployed periods to reflect the in-port and at-sea details of the schedule. In the FMPS, the deployed periods were fragmented for only the DDG. Changing the treatment of the deployed periods (fragmented or intact) affects the average weeks in port per year. This, in turn, has some impact on the training burden. In addition, the change in in-port time impacts on capability. The simulations were designed to quantify both options and aid in determining the significance of the differences.

3.10 The three manning levels closely scrutinized were the SMD Condition III, OpNav 1000/2 authorized, and actual average. Although there are internal exceptions, manning level is highest with the SMD option and lowest with the actual average option. Since there is a question as to which is the most realistic level for peacetime planning, these three were used to bracket the problem in terms of quantitative impact.

3.11 The training requirement investigations are related to the manning level issue. The simulations used in the exploration of alternative manning levels employed the standard SMD allowances for training. Composite training requirements developed in the study are now applied at two manning levels to determine the impact generated by the fixed versus variable dimensions of the training requirements.

IMBALANCE PROFILE ANALYSIS

Explanation

3.12 The analyses conducted in the FMPS established the need to consider more than the one-point-in-time situations if the existence and acuteness of a manning problem are to be established. For this reason, the ship work load algorithm was designed to provide as many as 10 assessments during the period analyzed.

3.13 Review of the multi-point-in-time results provides a profile of the work load/capability situation for each work center. These profiles fall into four separate and significant categories that are defined by the trend with time. The categories are defined in Paragraph 4.2 of the findings section and can be summarized as follows:

- Continuing increase in deferred work accrual with no slack
- Fluctuating deferred work accrual with no slack
- Continuing increase in slack with no deferred work accrual
- Both deferred work and slack present.

Application

3.14 The simulations pertinent to the selective parameter appraisals were analyzed relative to the profiles indicated. Results were categorized and documented accordingly. In this

manner, the work centers in need of help are readily identified from those that are undertasked and, therefore, candidates for assistance.

3.15 As an added dimension, the absolute values of deferred work or slack at the end of the schedule were divided by the number of weeks in the schedule and manning level of the work center. This adds a relative valuation that allows a viewing of the imbalance in hours per billet per week (the basic dimensions used in SMD billet determinations).

IV. FINDINGS

4.1 This section presents the results of simulations conducted to determine the work load versus capability situation under a variety of options for the selected sensitivity parameters discussed in Section III. The findings documented here are summaries of the algorithm report outputs. Results reflect the work load versus capability profile over the course of the operational schedule and are categorized to simplify identification of problem work centers--those that are overworked and those that are overstaffed.

PRESENTATION OF RESULTS

4.2 Four categories of work center imbalance profiles were defined as follows:

a. Work centers with continuing increase in deferred work accrual and zero slack through all phases.

b. Work centers with fluctuating deferred work accrual at various points in the schedule and zero slack through all phases.

c. Work centers with a continuing increase in accrued slack and no deferred work through all phases.

d. Work centers with both deferred work and slack.

4.3 The detailed and summary reports of the algorithm were analyzed for each simulation or set, and work center results (where imbalances occurred) were entered into tables for the applicable categories. Work centers in each category are arrayed in descending order of impact.

4.4 Scope. As indicated in Section III, the various simulations encompassed all of the pertinent sensitivity parameters of the algorithm. For a number of these, the quantified imbalances as depicted in the output reports are self-explanatory. Other parameters raise questions of appropriate options for depicting the baseline situation. These are addressed in the following paragraphs to allow comparison of the option impacts and to assist in the final definition of baseline parameters.

OPERATIONAL SCHEDULE (OPSKED) ANALYSIS

Simulation Description

4.5 Separate simulations were performed with two different forms of a typical OPSKED. One treated "deploy" as a single at-sea phase. The other fragmented the deployment periods into the various in-port and at-sea phases typically encountered. The parameter options that were common to both simulations are provided in Table 4.1. The detailed sequence of phases for each OPSKED is listed in Appendix A.

4.6 With the deployment period of one OPSKED broken into component in-port and at-sea phases, the following average times in port per year resulted:

TABLE 4.1

COMMON SIMULATION PARAMETERS FOR OPSKED ANALYSIS

Parameter	Option Selected
Manning level	SMD Condition III
Work load	Condition IV, at sea
	Condition V, cold iron in port
Work load variance	PM variance--applied
UA/TAD/leave	Applied
Training	SMD allowances

- 28 wk in port per year with the deployment period fragmented
- 20 wk in port per year with each deployment treated as a single, all at-sea phase.

Thus, the simulations reflect substantially different concentrations of in-port time.

Results

4.7 Imbalances Using Typical OPSKED With Deploy as All At-Sea Phase. Tables 4.2 through 4.5 contain the resulting work center imbalance profiles of this option. Work centers showing the largest end-of-schedule work deferral were the following:

- A Division MM--20,095 deferred hours
- E Division EM--18,156 deferred hours
- D2 Division GMG--18,037 deferred hours.

The following work centers showed the greatest slack accumulation:

- OI Division OS--153,248 slack hours
- F1 Division FTM--40,046 slack hours
- F2 Division STG--39,955 slack hours.

4.8 Imbalances Using Typical OPSKED With Deploy Fragmented Into In-Port and At-Sea Component Phases. Tables 4.6 through 4.9 show the profile category findings for this simulation.

TABLE 4.2

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK--DEPLOY AS ALL AT-SEA PHASE

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	YN	32.3	12,343
A	EN	22.0	8,408
A	MM	17.5	20,095
E	EM	13.6	18,156
S3	SH	13.6	12,908
D2	GMG	11.7	18,037
S2	MS	11.1	17,093
F2	TM	6.3	2,400
B	BT	2.6	15,028
D1	BM	1.8	12,115

TABLE 4.3

IMBALANCE DATA FOR WORK CENTERS WITH FLUCTUATING DEFERRAL AND NO SLACK--DEPLOY AS ALL AT-SEA PHASE

Work Center		Deferral					
				Maximum		Minimum	
Div.	Rating	Average/ Man/Week, hr	End of Schedule Total, hr	Hour	Week No.	Hour	Week No.
R	HT	0.1	366	1,448	74	168	2

TABLE 4.4

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL--DEPLOY AS ALL AT-SEA PHASE

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
M	MM	2.4	12,466
A	MR	6.1	1,173
S1	SK	6.2	8,232
OC	SM	7.2	8,261
F2	STG	11.2	39,955
F2	GMT	15.4	20,504
AD	SN	21.9	8,357
OI	EW	26.6	35,477
OI	OS	27.6	153,248
F1	FTM	30.0	40,046

TABLE 4.5

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--DEPLOY AS ALL AT-SEA PHASE

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.	Hour	Week No.		
S5	MS	1.1	1,722	1,855	188	0	2	0.1	908
X	PN	0.9	528	757	126	0	74	3.2	1,858
H	HM	0.3	103	173	126	0	74	2.1	819
OE	ET	0.3	308	1,229	74	0	188	4.5	5,118
S4	DK	0.2	83	143	126	0	74	1.9	727
N	QM	0.1	69	117	126	0	166	1.1	1,037
E	IC	0.1	73	165	126	0	166	1.7	1,612
X	PC	0.1	24	65	126	0	147	3.4	645
OC	RM	0.1	219	839	126	0	147	4.3	10,841
F	FTG	0*	1	4	74	0	188	6.0	6,921
X	MA	0	0	77	126	0	191	10.0	1,908
X	PO	0	0	77	126	0	191	10.0	1,908
D1	YN	0	0	65	126	0	191	10.3	1,965
A	YN	0	0	65	126	0	191	10.3	1,965

* Less than 0.05.

TABLE 4.6

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK--DEPLOY FRAGMENTED INTO IP AND AS PHASES

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	YN	38.6	14,736
A	EN	25.1	9,569
A	MM	21.0	24,137
D2	GMG	13.2	23,574
S3	SH	13.2	12,556
E	EM	12.3	16,448
F2	TM	8.7	3,333
S2	MS	3.9	13,443
B	BT	2.4	13,947
D1	BM	1.2	7,747

TABLE 4.7

IMBALANCE DATA FOR WORK CENTERS WITH FLUCTUATING DEFERRAL AND NO SLACK--DEPLOY FRAGMENTED INTO IP AND AS PHASES

Work Center		Deferral					
				Maximum		Minimum	
Div.	Rating	Average/ Man/Week, hr	End of Schedule Total, hr	Hour	Week No.	Hour	Week No.
R	HT	0.7	2,012	2,086	141	56	3

TABLE 4.8

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL--DEPLOY FRAGMENTED INTO IP AND AS PHASES

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
N	QM	1.9	1,766
E	IC	2.8	2,708
M	MM	2.9	15,103
A	MR	7.9	1,517
S1	SK	8.2	10,927
OC	SM	9.4	10,856
F2	STG	11.8	41,970
OI	EW	23.2	30,902
AD	SN	24.2	9,246
OI	OS	26.8	148,715
F1	FTM	26.9	35,890

TABLE 4.9

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--DEPLOY FRAGMENTED INTO IP AND AS PHASES

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.*	Hour	Week No.*		
OE	ET	0.5	615	1,512	74	208	2	0.2	179
F2	GMT	0**	24	24	191	0	166	12.7	16,965
S5	MS	0	0	220	147	0	191	1.4	2,092
S4	DK	0	0	27	126	0	191	3.5	1,326
H	HM	0	0	33	126	0	191	4.0	1,514
F	FTG	0	0	25	63	0	191	4.6	5,343
X	PC	0	0	13	126	0	191	5.6	1,063
OC	RM	0	0	127	126	0	191	7.0	17,414
X	PN	0	0	146	126	0	191	7.1	4,105
X	PO	0	0	15	126	0	191	15.2	2,906
X	MA	0	0	15	126	0	191	15.2	2,906
D1	YN	0	0	13	126	0	191	15.4	2,949
A	YN	0	0	13	126	0	191	15.4	2,949

* If there is a multiple occurrence, then the week given is the last occurrence in OPSKED.

** Less than 0.05 hour per week per man.

4.9 Only three work centers changed work load profile categories as a result of the different treatment for the phase deploy. These were:

a. N Division QM (from "Both Deferral and Slack Present" to "Continuing Increase in Slack--No Deferred Work")

b. E Division IC (from "Both Deferral and Slack Present" to "Continuing Increase in Slack--No Deferred Work")

c. F2 Division GMT (from "Continuing Increase in Slack--No Deferred Work" to "Both Deferral and Slack Present").

The values of the imbalance statistics, however, fluctuated considerably at the work center level. For example, viewing the high-value work centers with deploy fragmented relative to the results obtained with deploy as a single phase shows the following changes:

- A Division MM--4,042-hr increase in deferral (20%)
- E Division EM--1,708-hr decrease in deferral (9%)
- D2 Division GMG--5,537-hr increase in deferral (31%)
- OI Division OS--4,533-hr decrease in slack (3%)

- F1 Division FTM--4,156-hr decrease in slack (10%)
- F2 Division STG--2,015-hr increase in slack (5%).

Summary

4.10 The deferral and slack values associated with individual work centers were highly sensitive to the design of the OPSKED. Department level end-of-schedule deferral and slack values, as shown in Table 4.10, also experienced noticeable shifts when one OPSKED was substituted for the other. At the ship level, however, work centers and departmental fluctuations were dampened, with roughly 1% difference in deferral and slack resulting from OPSKED substitution.

4.11 In view of the sensitivity of OPSKED design shown in the foregoing and in previous analyses of the Fleet Manpower Policy Study, [1/] the same OPSKED (typical with deploy fragmented) was used in all subsequent investigations summarized in this report.

MANNING LEVEL ANALYSIS

Simulation Descriptions

4.12 Five separate manning level options were simulated: (a) SMD Condition III, (b) notional SMD Condition V, (c) actual, (d) actual average, and (e) OpNav 1000/2 authorized. Except

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1/ Presearch Incorporated, Fleet Manpower Policy Study, Technical Report No. 290, Arlington, Virginia, February 1976.

TABLE 4.10

COMPARATIVE DEPARTMENT SUMMARY OF DEFERRAL AND SLACK FOR OPSKED ANALYSIS*

Department	Typical OPSKED			
	With Deploy Intact		With Deploy Fragmented	
	Deferral, hr	Slack, hr	Deferral, hr	Slack, hr
Executive	12,895	6,319	14,736	10,980
Navigation	69	1,037	0	1,766
Medical	103	819	0	1,514
Operations	526	212,945	615	208,066
Air	0	8,357	0	9,246
Weapons	32,553	109,391	34,678	103,117
Engineering	62,127	17,217	66,113	22,277
Supply	31,807	9,867	25,999	14,345
Total	140,080	365,952	142,141	371,311

* OPSKED of 191 wk; end of schedule statistics.

for the actual manning option, which is meaningful only when considered in conjunction with the corresponding actual OPSKED, common options were used for all other parameters, as indicated in Table 4.11.

TABLE 4.11
COMMON SIMULATION PARAMETERS IN MANNING LEVEL ANALYSIS

Parameter	Option Selected
OPSKED	Typical--deploy fragmented
Work load	Condition IV, at sea
	Condition V, cold iron in port
Work load variance	PM variance--applied
UA/TAD/leave	Applied
Training	SMD allowances

4.13 Results of two options--actual average and OpNav 1000/2--were evaluated for manning level impact. The SMD III manning option was previously used in conjunction with the OPSKED analysis; results are not repeated here. In addition to categorization of the absolute imbalances for the two options evaluated, a departmental comparison was made with the SMD Condition III results to demonstrate the relative severity of imbalances associated with the decrement from requirements that is embodied in the authorized and FF-1053 actual average manning levels.

Results

4.14 Imbalances Using OpNav 1000/2 Authorized Manning. Imbalances occurred in all four categories, with relatively large deferred work values in several work centers. Results for all categories are presented in Tables 4.12 through 4.15.

TABLE 4.12

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK-- OPNAV 1000/2 AUTHORIZED MANNING

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	PN	62.5	11,947
X	YN	38.6	14,736
S4	DK	33.9	6,483
A	MM	33.5	31,946
B	BT	31.6	112,866
R	HT	25.1	43,228
S2	MS	12.9	36,869
S5	MS	11.8	13,525
F2	TM	8.7	3,333
N	QM	7.9	6,043
E	EM	5.6	8,639
D1	BM	5.0	31,173
S3	SH	4.1	4,747

TABLE 4.13

IMBALANCE DATA FOR WORK CENTERS WITH FLUCTUATING DEFERRAL AND NO SLACK--OPNAV 1000/2 AUTHORIZED MANNING

Work Center		Deferral					
				Maximum		Minimum	
Div.	Rating	Average/ Man/Week, hr	End of Schedule Total, hr	Hour	Week No.	Hour	Week No.
D2	GMG	4.1	7,956	7,956	191	228	3
A	EN	3.1	1,761	1,761	191	56	3

TABLE 4.14

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL-- OPNAV 1000/2 AUTHORIZED MANNING

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
OI	EW	28.2	54,328
F	FTG	9.9	13,151
OC	SM	9.4	10,856
A	MR	7.9	1,517
E	IC	2.8	2,708
M	MM	1.5	7,295

TABLE 4.15

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--
OPNAV 1000/2 AUTHORIZED MANNING

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.	Hour	Week No.		
S1	SK	5.0	4,767	4,786	188	0	2	0.1	76
OE	ET	0.3	344	797	74	0*	166	5.8	7,716
F2	GMT	0.1	128	433	74	0*	166	8.1	9,260
F1	FTM	**	20	73	74	0*	166	8.1	4,674
H	HM	0	0	33	126	0*	191	4.0	1,514
OC	RM	0	0	385	126	0*	191	4.2	9,605
X	PC	0	0	12	126	0*	191	5.6	1,063
F2	STG	0	0	171*	166	0*	191	6.1	18,544
OI	OS	0	0	46	126	0*	191	7.0	15,965
X	PO	0	0	15	126	0*	191	15.2	2,903
A	YN	0	0	12	126	0*	191	15.4	2,949

* Multiple occurrence; the week given is the last occurrence in OPSKED.

** Less than 0.1.

4.15 Imbalances Using FF-1053 Actual Average Manning Level. Results are presented in Tables 4.16 through 4.18. Only three categories are represented, as no work centers showed a fluctuating deferral with no slack.

4.16 Table 4.19 presents a departmental and ship level summary of end-of-schedule deferred work and slack for the SMD Condition III, authorized, and actual average manning levels. With this one-point-in-time comparison, the relative impact of imbalances at the various manning levels may be ascertained. For example, note the following ratios of deferred work to slack at the ship level:

- SMD Condition III manning--2.6 to 1
- Authorized manning level--0.5 to 1
- FF-1053 actual average manning level--0.2 to 1.

COMPOSITE AUTHORITY TRAINING

Simulation Descriptions

4.17 Two simulations were conducted to determine the impact of composite authority training requirements on productive availability as well as to identify the imbalances attendant to both SMD Condition III and OpNav 1000/2 authorized manning levels. In addition to the composite authority training requirements, the options common to both simulations are provided in Table 4.20.

TABLE 4.16

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK-- ACTUAL AVERAGE MANNING LEVEL

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	YN	38.6	14,736
D2	GMG	34.5	39,625
S4	DK	33.9	6,483
A	MM	33.5	31,946
F2	GMT	28.9	14,295
S2	MS	21.0	52,487
D1	BM	20.9	94,948
B	BT	18.4	79,893
S3	SH	13.2	12,556
R	HT	12.8	26,741
E	EM	12.3	16,448
S5	MS	11.8	13,525
F2	TM	8.7	3,333
M	MM	3.7	16,133

TABLE 4.17

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL--ACTUAL AVERAGE MANNING LEVEL

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
OE	ET	18.5	38,608
A	EN	14.5	13,857
A	MR	7.9	1,517
E	IC	2.8	2,708
N	QM	1.9	1,766

TABLE 4.18

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--
ACTUAL AVERAGE MANNING LEVEL

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.	Hour	Week No.		
OC	RM	9.9	17,018	17,018	191	0	2	0.1	137
X	PN	9.9	3,778	3,803	188	0	2	0.2	75
S1	SK	5.0	4,767	4,786	188	0	2	0.1	76
OI	OS	4.4	7,594	7,639	188	0	2	0.1	132
OI	EW	**	36	131	74	0*	166	9.9	7,510
F1	FTM	**	20	73	74	0*	166	8.1	4,674
OC	SM	0	0	288	147	0*	191	2.1	2,027
F2	STG	0	0	288	103	0*	191	3.8	10,735
H	HM	0	0	33	126	0*	191	4.0	1,514
F	FTG	0	0	25	63	0*	191	4.6	5,343
X	PC	0	0	12	126	0*	191	5.6	1,063
AD	SN	0	0	96	126	0*	191	7.5	1,437
D1	YN	0	0	12	126	0*	191	15.4	2,949
A	YN	0	0	12	126	0*	191	15.4	2,949

* Multiple occurrence; the week given is the last occurrence in OPSKED.

** Less than 0.1

TABLE 4.19

COMPARATIVE DEPARTMENT SUMMARY OF DEFERRAL AND SLACK FOR MANNING LEVEL ANALYSIS*

Department	Manning Level					
	SMD Condition III		OpNav 1000/2		FF-1053 Actual Average	
	Deferral, hr	Slack, hr	Deferral, hr	Slack, hr	Deferral, hr	Slack, hr
Executive	14,736	10,980	31,586	3,969	28,320	1,138
Navigation	0	1,766	6,043	0	0	1,766
Medical	0	1,514	0	1,514	0	1,514
Operations	615	208,066	344	98,471	24,648	48,414
Air	0	9,246	6,372	0	0	1,437
Weapons	34,678	103,117	47,471	45,629	152,221	23,701
Engineering	66,113	22,277	198,440	14,469	171,161	21,031
Supply	25,999	14,345	68,391	76	89,818	76
Total	142,141	371,311	358,647	164,128	466,168	99,077

* OPSKED of 191 wk; end of schedule statistics.

TABLE 4.20

COMMON SIMULATION PARAMETERS FOR COMPOSITE AUTHORITY TRAINING REQUIREMENTS ANALYSIS

Parameter	Option Selected
OPSKED	Typical--deploy fragmented
Work load	Condition IV, at sea
	Condition V, cold iron in port
Work load variance	PM variance--applied
UA/TAD/leave	Applied

4.18 The determination of productive availability lost to training is made possible by two additional simulations that had parameters identical to those above, except that a zero training requirement was specified. Using the algorithm outputs, the average capability was computed for each work center, in hours per week per man. The difference in capability between the two simulations at each manning level is the productivity impact attributable to the training requirement.

Results

4.19 Productivity Impact at SMD Condition III Manning Level. Table 4.21 shows the productivity impacts by work center. A weighted average was also computed for each department and for the ship total. No values appear for the XPO and XMA work centers because the FF-1053 did not assign anyone to these billets; hence, the assignment of a training requirement was dismissed as being too arbitrary in the absence of an incumbent with a specified rating.

TABLE 4.21

AVERAGE IMPACT ON PRODUCTIVITY OF COMPOSITE AUTHORITY TRAINING REQUIREMENT WITH SMD III MANNING

Department	Work Center		Average Training Impact, hours/man/week
	Division	Rating	
Executive	X	PO	Not computed
	X	MA	Not computed
	X	PC	5.0
	X	PN	4.7
	X	YN	5.9
Department average	--	--	5.2
Navigation	N	QM	6.5
Department average	--	--	6.5
Medical	H	HM	6.4
Department average	--	--	6.4
Operations	OC	RM	3.5
	OC	SM	4.7
	OE	ET	9.7
	OE	EW	7.0
	OI	OS	10.7
Department average	--	--	8.1
Air	AD	SN	4.4
Department average	--	--	4.4

TABLE 4.21 (Cont)

Department	Work Center		Average Training Impact, hours/man/week
	Division	Rating	
Weapons	D1	BM	7.2
	D1	YN	4.6
	D2	GMG	7.0
	F	FTG	7.4
	F1	FTM	5.9
	F2	GMT	7.9
	F2	STG	6.4
	F2	TM	9.1
Department average	--	--	7.0
Engineering	A	EN	12.8
	A	MM	9.2
	A	MR	8.0
	A	YN	5.8
	B	BT	5.7
	E	EM	10.9
	E	IC	9.0
	M	MM	11.9
	R	HT	11.4
Department average	--	--	9.3
Supply	S1	SK	3.5
	S2	MS	6.0
	S3	SH	6.4
	S4	DK	4.4
	S5	MS	5.2
Department average	--	--	5.4
Ship average	--	--	7.8

4.20 Imbalances at SMD Condition III Manning Level. Tables 4.22 through 4.25 contain the imbalances encountered with SMD manning and composite authority training requirements.

4.21 Productivity Impact at OpNav 1000/2 Authorized Manning Level. Table 4.26 shows the average impacts at this manning level for work centers, departments, and total ship.

4.22 Imbalances at OpNav 1000/2 Authorized Manning Level. Results are presented in Tables 4.27 through 4.29. At this manning level, there were no work centers in the imbalance profile category defined by fluctuating deferral and zero slack.

Summary

4.23 As indicated previously, training requirements are identified and entered into the data base in terms of fixed and variable requirements for each work center. The net effect of these dimensions on the final results is manifested by a greater impact in all departments when the lower (OpNav 1000/2) manning level is imposed (see Table 4.30). As a natural corollary to this, the productivity impacts are clearly reflected in the imbalance profiles for the two manning options.

TABLE 4.22

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK--COMPOSITE AUTHORITY TRAINING AND SMD III MANNING

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	YN	39.7	15,154
A	EN	33.1	12,619
A	MM	25.5	29,335
D2	GMG	17.5	26,893
E	EM	16.7	22,270
S3	SH	14.7	13,995
F2	TM	13.0	4,979
R	HT	7.5	20,339
S2	MS	5.0	17,322
D1	BM	4.4	29,403
B	BT	4.0	23,725
M	MM	2.7	14,161
E	IC	2.0	1,910

TABLE 4.23

IMBALANCE DATA FOR WORK CENTERS WITH FLUCTUATING DEFERRAL AND NO SLACK--COMPOSITE AUTHORITY TRAINING AND SMD III MANNING

Work Center		Deferral					
				Maximum		Minimum	
Div.	Rating	Average/ Man/Week, hr	End of Schedule Total, hr	Hour	Week No.	Hour	Week No.
OE	ET	5.2	5,980	5,980	191	341	2
N	QM	0.6	524	524	191	37	2

TABLE 4.24

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL--COMPOSITE AUTHORITY TRAINING AND SMD III MANNING

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
S4	DK	3.9	1,507
A	MR	4.8	924
X	PC	5.3	1,019
OC	RM	7.2	17,944
OC	SM	8.4	9,616
S1	SK	9.5	12,706
F2	STG	9.6	34,136
A	YN	14.5	2,771
D1	YN	15.7	2,998
X	PO	20.1	3,834
X	MA	20.1	3,834
OI	OS	20.6	114,264
OI	EW	20.9	27,927
AD	SN	24.7	9,438
F1	FTM	25.9	34,506

TABLE 4.25

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--
COMPOSITE AUTHORITY TRAINING AND SMD III MANNING

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.	Hour	Week No.		
F	FTG	0.2	212	474	74	0*	126	2.2	2,570
F2	GMT	0.2	237	259	188	0*	166	9.8	13,030
S5	MS	0	0	50	126	0*	191	1.0	1,517
H	HM	0	0	10	126	0*	191	1.6	906
X	PN	0	0	87	126	0*	191	7.3	4,188

* Multiple occurrence; the week given is the last occurrence in OPSKED.

TABLE 4.26

AVERAGE IMPACT ON PRODUCTIVITY OF COMPOSITE AUTHORITY TRAINING REQUIREMENT-- OPNAV 1000/2 AUTHORIZED MANNING

Department	Work Center		Average Training Impact, hours/man/week
	Division	Rating	
Executive	X	PO	Not computed
	X	MA	Not computed
	X	PC	5.6
	X	PN	6.1
	X	YN	6.7
Department average	--	--	6.3
Navigation	N	QM	8.1
Department average	--	--	8.1
Medical	H	HM	7.0
Department average	--	--	7.0
Operations	OC	RM	4.0
	OC	SM	5.1
	OE	ET	10.9
	OE	EW	7.5
	OI	OS	15.8
Department average	--	--	8.9

TABLE 4.26 (Cont)

Department	Work Center		Average Training Impact, hours/man/week
	Division	Rating	
Weapons	D1	BM	8.8
	D1	YN	0.0
	D2	GMG	7.8
	F	FTG	8.0
	F1	FTM	8.0
	F2	GMT	9.8
	F2	STG	7.2
	F2	TM	10.1
Department average	--	--	8.3
Engineering	A	EN	12.4
	A	MM	12.0
	A	MR	9.4
	A	YN	6.6
	B	BT	7.7
	E	EM	9.6
	E	IC	10.6
	M	MM	11.9
	R	HT	15.5
Department average	--	--	10.9
Supply	S1	SK	4.0
	S2	MS	7.4
	S3	SH	6.7
	S4	DK	5.7
	S5	MS	6.5
Department average	--	--	6.5
Ship average	--	--	9.0

TABLE 4.27

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN DEFERRAL AND NO SLACK-- COMPOSITE AUTHORITY TRAINING AND AUTHORIZED MANNING

Work Center		Deferral, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
X	PN	63.8	12,194
A	MM	40.9	38,944
X	YN	40.5	15,473
R	HT	36.1	62,272
B	BT	35.7	127,618
S4	DK	33.8	6,469
S2	MS	15.4	44,085
F2	TM	14.1	5,383
S5	MS	13.4	15,452
N	QM	12.0	9,191
E	EM	10.8	16,548
A	EN	10.6	6,082
D1	BM	9.8	61,353
D2	GMG	6.5	12,535
M	MM	6.4	32,091
S3	SH	6.0	6,904
OI	OS	4.9	11,102
E	IC	3.7	3,489

TABLE 4.28

IMBALANCE DATA FOR WORK CENTERS WITH CONTINUING INCREASE IN SLACK AND NO DEFERRAL--COMPOSITE AUTHORITY TRAINING AND AUTHORIZED MANNING

Work Center		Slack, hr	
Division	Rating	Average/Man/Week	End of Schedule Total
OI	EW	25.6	49,290
X	PO	20.1	3,834
A	YN	13.7	2,618
OC	SM	8.0	9,194
X	PC	4.7	900
A	MR	3.3	640

TABLE 4.29

IMBALANCE DATA FOR WORK CENTERS WITH BOTH DEFERRAL AND SLACK--
COMPOSITE AUTHORITY TRAINING AND AUTHORIZED MANNING

Work Center		Deferral						Slack, hr	
Division	Rating	Average/Man/ Week, hr	End of Schedule Total, hr	Maximum		Minimum		Average/Man/ Week	End of Schedule Total
				Hour	Week No.	Hour	Week No.		
S1	SK	4.1	3,881	3,886	188	0	0	0.1	51
OE	ET	0.7	985	2,373	77	333	2	0.2	292
F2	GMT	0.5	597	1,193	74	0*	126	3.5	4,074
F1	FTM	0.3	152	361	74	0*	166	5.2	2,970
F	FTG	0.1	82	302	74	0*	166	6.7	8,901
H	HM	0	0	10	126	0*	191	1.9	709
F2	STG	0	0	140*	166	0*	191	3.1	9,392
OC	RM	0	0	238	126	0*	191	3.9	8,806

* Multiple occurrence; the week is the last occurrence in OPSKED.

TABLE 4.30

IMPACT OF COMPOSITE AUTHORITY TRAINING REQUIREMENTS ON PRODUCTIVITY-- DEPARTMENT AND SHIP AVERAGES (SMD III and authorized manning levels)

Department	Impact, hours/week/man	
	SMD III Manning	Authorized Manning
Executive	5.2	6.3
Navigation	6.5	8.1
Medical	6.4	7.0
Operations	8.1	8.9
Weapons	7.0	8.3
Engineering	9.3	10.9
Supply	5.4	6.5
Ship Average	7.8	9.0

APPENDIX A
OPERATIONAL SCHEDULES

A.1 The OPSKEDs used in the analyses are of two basic types: typical and actual. The typical schedules are from inputs provided by OP-642 via OP-121. The actual schedule was reconstructed from ships' records. Both types were tailored to arrive at OPSKEDs with common phase names and, as required, to define phases in terms of whole weeks. The actual OPSKED is in Table A.1. The typical OPSKEDs, with deploy intact and with deploy fragmented, are in Tables A.2 and A.3, respectively.

A.2 In view of the relatively large number of official phase identifiers, some use was made of phase categories or phase name "collectors" to avoid excessive fragmentation of the schedule. Table A.4 shows the official phase identifiers, the abbreviations used, and the relationship to the phase name collectors.

TABLE A.1
ACTUAL OPSKED

Week	Phase	Week	Phase	Week	Phase
1	TYT	25	FLEETEX	51	TYT
2	UPK	26-29	UPK	52-53	UPK
3	ISE	30	TRAV	54-55	ENR
4-5	UPK	31-32	UPK	56-57	FLEETEX
6-8	RFT	33-34	FLEETEX	58-59	UPK
9-13	UPK	35	UPK	60	ENR
14	MTT	36-39	RFS	61-64	UPK
15	UPK	40-42	GRUSL	65	ISE
16	ISE	43	FLEETEX	66	ENR
17	UPK	44	ENR	67-68	UPK
18	MTT	45-46	ESC	69-70	GRUSL
19	FLEETEX	47-48	UPK	71	ENR
20	RFT	49	ISE	72-76	UPK
21-24	FLEETEX	50	UPK	77-86	IMAUPK

TABLE A.2

TYPICAL OPSKED--DEPLOY INTACT
(ROH to ROH)

Week	Phase	Week	Phase	Week	Phase
0	ROH*	35-36	UPK	126	ENR
1-2	RFS	37-38	RFS	127-137	UPK
3	ISE	39-40	GRUSL	138-141	TYT
4-5	UPK	41-62	Deploy	142	FLEETEX
6-7	RFT	63	ENR	143	ENR
8-12	UPK	64-74	UPK	144-145	ESC
13	MTT	75-78	TYT	146-147	UPK
14	ENR	79	FLEETEX	148	ISE
15	ISE	80	ENR	149	ENR
16-17	UPK	81-82	ESC	150	TYT
18	MTT	83-84	UPK	151-152	UPK
19	FLEETEX	85-86	ISE	153-154	ENR
20	RFT	87-89	UPK	155-156	FLEETEX
21-24	UPK	90-91	ENR	157-163	UPK
25	FLEETEX	92-93	FLEETEX	164	ISE
26-28	UPK	94-99	UPK	165-166	GRUSL
29	TRAV	100	ISE	167-187	Deploy
30	ISE	101	ENR	188	ENR
31-32	UPK	102-103	GRUSL	189-191	UPK
33-34	FLEETEX	104-125	Deploy	192	ROH*

*Not used.

TABLE A.3

TYPICAL OPSKED--DEPLOY FRAGMENTED
(ROH to ROH)

Week	Phase	Week	Phase	Week	Phase
0	ROH*	57	RFT	126	ENR
1-2	RFS	58-59	UPK	127-137	UPK
3	ISE	60	GRUSL	138-141	TYT
4-5	UPK	61-62	TYT	142	FLEETEX
6-7	RFT	63	ENR	143	ENR
8-12	UPK	64-74	UPK	144-145	ESC
13	MTT	75-78	TYT	146-147	UPK
14	ENR	79	FLEETEX	148	ISE
15	ISE	80	ENR	149	ENR
16-17	UPK	81-82	ESC	150	TYT
18	MTT	83-84	UPK	151-152	UPK
19	FLEETEX	85-86	ISE	153-154	ENR
20	RFT	87-89	UPK	155-156	FLEETEX
21-24	UPK	90-91	ENR	157-163	UPK
25	FLEETEX	92-93	FLEETEX	164	ISE
26-28	UPK	94-99	UPK	165-166	GRUSL
29	TRAV	100	ISE	167	FLEETEX
30	ISE	101	ENR	168	ENR
31-32	UPK	102-103	GRUSL	169-170	ESC
33-34	FLEETEX	104-106	FLEETEX	171-172	UPK
35-36	UPK	107-108	UPK	173-174	TRAV
37-38	RFS	109-110	ESC	175	TYT
39-40	GRUSL	111-112	TECHAV	176-177	UPK
41-44	ESC	113-114	UPK	178-179	ENR
45	RFT	115	LOAD/OFLD	180-181	FLEETEX
46-48	TECHAV	116-117	TYT	182	ENR
49-50	TYT	118-119	UPK	183	TYT
51	TRAV	120	TRAV	184-187	UPK
52-53	UPK	121-123	ESC	188	ENR
54	LOAD/OFLD	124	FLEETEX	189-191	UPK
55-56	FLEETEX	125	ISE	192	ROH*

*Not used

TABLE A.4
PHASE NAMES AND ABBREVIATIONS

Environment/ Function		Official Phase Identifications			Phase Name "Collector"		
		No.	Category	Abbrev.	No.	Category	Abbrev.
Maintenance		1.	Regular Overhaul	ROH	(--)	(--)	
		2.	Technical Availability (Tender)	TAV/TECHAV	1	Same	Same
		3.	Restricted Availability	RAV	2	Same	Same
		4.	Intermediate Maintenance Activity Upkeep	IMAUPK	3	Same	Same
At Sea	Operations and Exercises	5.	Fleet Exercises	FLEET-EX	4	Fleet Exercises	FLEET-EX
		6.	Multiple Ship Exercises	READI-EX			
		7.	Missile Exercises	MSLEX			
		8.	Anti-Submarine Warfare Exercises	ASWEX			
		9.	Independent Steaming Exercises	ISE	5	Independent Steaming Exercise	ISE
		10.	Operational Propulsion Plant Examination	OPPE			
		11.	Plane Guard	PLG	6	Escort Service	ESC
		12.	Escort Services	ESC			
		13.	Group Sail	GRUSL	7	Group Sail	GRUSL
		14.	Multi-Sail	MLTSL			
		15.	Enroute	ENR	8	Same	Same
	Training	16.	Mobile Team Training	MTT	9	Same	Same
		17.	Refresher Training	RFT	10	Same	Same
		18.	Type Training	TYT	11	Type Training	TYT
		19.	Coordinated Anti-Submarine Services Training	CAST			
		20.	Weapons System Acceptance Training	WSAT			
In Port	Operation, Exercises, and Inspections	21.	Upkeep	UPK	12	Upkeep	UPK
		22.	In-port	IPT			
		23.	Brief Stop	MA/BSP			
		24.	Visit	VST			
		25.	Leave and Upkeep	LVUPK			
		26.	Nuclear Weapons Acceptance Inspection	NWAI			
		27.	Medical Inspector	MEDINSP			
		28.	Technical Standardization Inspection	TSI			
		29.	Ready for Sea	RFS	13	Ready for Sea	RFS
		30.	Preparation for Overseas Movement	POM			
		31.	Load Out	LOAD	14	Load/Off Load	LOAD/OFLD
		32.	Off Load	OFLD			
	Training	33.	Training Availability	TRAV	15	Training Availability	TRAV
		34.	Nuclear Weapons Acceptance Training	NWAT			
		35.	Unit Training	UNITNG			
		36.	Combat Systems Readiness Training	CSRT			

APPENDIX B
TRAINING REQUIREMENTS DATA

B.1 This appendix contains the training requirements data developed and used in the study analyses. The requirements are stated by work center and are broken down to reflect the fixed and variable requirements for both on-board and off-ship training.

B.2 Requirements imposed by higher authority, at ship level, and the composite of these are reflected in Tables B.1, B.2 and B.3, respectively.

TABLE B.1

HIGHER AUTHORITY TRAINING REQUIREMENT DATA

Work Center		On-Board Training		Off-Ship Training	
Division	Rating	Variable, hour/week/man	Fixed, hour/week	Variable, hour/year/man	Fixed, hour/year
X	PO	0	0	0	0
X	MA	0	0	0	0
X	PC	2.50	0	10.67	2.67
X	PN	2.76	0	10.67	56.34
X	YN	2.59	0.22	10.67	33.78
N	QM	2.63	0.30	10.67	368.00
H	HM	4.05	0.20	10.67	64.00
OC	RM	2.64	0.30	10.67	144.00
OC	SM	2.36	2.44	10.67	32.00
OE	ET	2.66	0.71	30.67	37.33
OI	EW	1.32	0.40	50.67	411.33
OI	OS	2.63	0.66	10.67	1,046.67
AD	SN	2.51	0	10.67	0
D1	BM	2.53	5.28	10.67	3,458.66
D1	YN	2.59	0	10.67	0
D2	GMG	2.61	1.19	10.67	336.00
F	FTG	2.44	0.42	37.33	149.34
F1	FTM	2.59	0.44	37.33	96.00
F2	GMT	2.44	1.90	10.67	760.21
F2	FTG	2.44	0.42	37.33	197.34
F2	TM	2.64	0.95	37.33	194.67
A	EN	2.67	0.62	10.67	632.00
A	MM	2.61	0.49	10.67	914.72
A	MR	2.76	0.15	10.67	186.67
A	YN	2.59	0.11	10.67	16.89
B	BT	2.61	1.23	10.67	1,850.67
E	EM	2.60	0.80	10.67	974.67
E	IE	2.62	0.62	10.67	648.00
M	MM	2.61	2.64	10.67	4,769.62
R	HT	2.59	1.60	10.67	1,541.33
S1	SK	2.66	0.26	10.67	32.00
S2	MS	2.36	1.54	10.67	1,139.13
S3	SH	2.59	0.88	10.67	394.68
S4	DK	2.76	0.10	10.67	2.67
S5	MS	2.29	0.48	10.67	383.94

TABLE B.2

SHIP LEVEL TRAINING REQUIREMENT DATA

Work Center		On-Board Training		Off-Ship Training	
Division	Rating	Variable, hour/week/man	Fixed, hour/week	Variable, hour/year/man	Fixed, hour/year
X	PO	0	0	0	0
X	MA	0	0	0	0
X	PC	0.85	0.08	0	70.00
X	PN	0.84	0	26.60	0
X	YN	0.85	0.45	51.55	55.55
N	QM	1.31	0.75	32.67	40.00
H	HM	0.84	0.35	5.34	40.00
OC	RM	0.84	0.50	10.88	256.66
OC	SM	0.94	0.56	32.67	0
OE	ET	2.43	0.41	60.00	821.33
OI	EW	1.49	0.37	17.33	642.00
OI	OS	5.57	0.88	12.00	1,156.00
AD	SN	1.13	0	27.00	0
D1	BM	1.12	9.80	28.65	989.33
D1	YN	0.84	0	51.55	0
D2	GMG	2.21	1.45	6.40	293.33
F	FTG	2.28	0.60	7.62	328.00
F1	FTM	1.67	0.31	3.05	182.67
F2	GMT	2.05	1.41	17.50	139.38
F2	FTG	2.54	2.00	23.62	440.00
F2	TM	3.14	0.38	5.34	0
A	EN	2.30	0.29	12.44	106.67
A	MM	1.79	0.69	67.73	76.00
A	MR	1.15	0.17	0	0
A	YN	0.84	0.23	51.55	27.78
B	BT	1.31	2.60	4.39	394.66
E	EM	2.06	0.82	6.10	321.33
E	IC	2.00	0.52	9.07	348.00
M	MM	1.81	3.60	65.54	394.67
R	HT	4.31	1.10	62.22	615.99
S1	SK	0.03	0.27	20.27	32.00
S2	MS	1.07	2.60	21.64	354.96
S3	SH	1.26	1.13	10.67	53.33
S4	DK	0.84	0.02	24.00	0
S5	MS	1.04	0.74	19.34	117.65

TABLE B.3
COMPOSITE TRAINING REQUIREMENT DATA

Work Center		On-Board Training		Off-Ship Training	
Division	Rating	Variable, hour/week/man	Fixed, hour/week	Variable, hour/year/man	Fixed, hour/year
X	PO	0	0	0	0
X	MA	0	0	0	0
X	PC	3.35	0.08	10.67	72.67
X	PN	3.60	0	37.27	56.34
X	YN	3.44	0.67	66.22	89.33
N	QM	3.94	1.05	44.39	408.00
H	HM	4.89	0.55	16.01	104.00
OC	RM	3.48	0.80	21.55	400.66
OC	SM	3.30	3.00	43.34	32.00
OE	ET	5.09	1.12	90.67	858.66
OI	EW	2.81	0.77	68.00	1,053.33
OI	OS	8.20	1.54	22.67	3,102.67
AD	SN	3.64	0	31.67	0
D1	BM	3.65	15.08	39.52	4,447.99
D1	YN	3.43	0	62.22	0
D2	GMG	4.82	2.64	17.07	629.33
F	FTG	4.72	1.02	44.95	525.34
F1	FTM	4.26	0.75	40.38	278.67
F2	GMT	4.49	3.31	28.17	899.59
F2	FTG	4.98	2.42	37.33	637.34
F2	TM	5.78	1.33	42.67	194.67
A	EN	4.97	0.91	23.11	738.67
A	MM	4.40	1.18	78.40	990.72
A	MR	3.91	0.32	10.67	186.67
A	YN	3.43	0.34	62.22	44.67
B	BT	3.92	3.83	15.06	2,260.39
E	EM	4.66	1.62	16.77	1,296.00
E	IE	4.62	1.14	19.74	996.00
M	MM	4.42	6.24	76.21	5,164.29
R	HT	6.90	2.70	72.89	2,157.32
S1	SK	2.69	0.53	30.94	64.00
S2	MS	3.43	6.74	32.31	1,494.09
S3	SH	3.85	2.01	21.34	448.01
S4	DK	3.60	0.12	34.67	2.67
S5	MS	3.33	1.22	30.01	501.59